



**KERR-McGEE CHEMICAL CORPORATION**

KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

164374

October 31, 1986

James L. Morgan, Esq.  
Assistant Attorney General  
Environmental Control Division  
Attorney General's Office  
500 S. Second Street  
Springfield, IL 62706

Dear Mr. Morgan:

Enclosed please find the report entitled "Preliminary Report for the Former Moss-American Site, Sauget, Illinois". The report presents the results of the Preliminary Assessment, conducted by Kerr-McGee Chemical Corporation, Lefton Iron & Metal Company, and ERT, of the Moss-American site, in preparation for developing the Remedial Investigation Work Plan. The Work Plan is scheduled to be submitted by December 2, 1986.

Should you have any questions, do not hesitate to contact me at 405/270-2391.

Sincerely,

KERR-McGEE CHEMICAL CORPORATION  
FOREST PRODUCTS DIVISION

Jeffrey H. Bull, Manager  
Environmental Control &  
Regulatory Affairs

JHB:kr

cc: Maxine Lipeles

SCREENED  
*[Handwritten mark]*



**FOREST  
PRODUCTS**

**RECEIVED**

SEP 22 1998

U.S. EPA, REGION 5  
Office of Regional Counsel

**Preliminary Report for the  
Former Moss-American Site  
Sauget, Illinois**

Prepared for:

**Kerr-McGee Chemical Corporation  
and Lefton Iron and Metal Company**

November 1986

**ERT**

**A RESOURCE ENGINEERING COMPANY**

## TABLE OF CONTENTS

<u>Description</u>	<u>Page</u>
1.0 INTRODUCTION	1
2.0 SITE BACKGROUND/EXISTING DATA REVIEW	3
2.1 Operating History	3
2.2 Waste and Stormwater Management	6
2.2.1 Process Waste Management	6
2.2.2 Stormwater Management	7
2.3 Regulatory Involvement and History of Response Actions	8
2.4 Area Geology	11
3.0 NATURE AND EXTENT OF PROBLEM	13
3.1 Composition and Effects of Creosote	13
3.2 Behavior of Creosote Constituents	16
3.3 Composition and Effects of Pentachlorophenol	17
3.4 Behavior of Pentachlorophenol	19
4.0 PATHWAYS OF EXPOSURE	21
4.1 Direct Contact	21
4.2 Air Migration	21
4.3 Stormwater Runoff	22
4.4 Groundwater Impacts	26
5.0 SITE MAP/INVESTIGATION SUPPORT	29
5.1 Topographic Map	29
5.2 Site Survey	29
5.3 Surrounding Land Owners	29
5.4 U.S.G.S. Quadrangle Map	29
5.5 Sub-Surface Piping	30
6.0 POTENTIAL REMEDIAL ACTIONS	31
6.1 Sludges	32
6.2 Soils	34
6.3 Water	35

## LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Analytical Results from the KMCC/LIMC Portion of the Field Samples Obtained March 19, 1986	10
2	Properties of Creosote Constituents	15
3	Properties of Pentachlorophenol	20
4	K <sub>oc</sub> Fractional Organic Partition	23
5	Long Term Runoff Concentrations Accounting for the Effect of Biodegradation	25
6	Retardation Factors (R <sub>d</sub> ) for Transport in Groundwater	27

## LIST OF ATTACHMENTS

### Attachment

- 1 July, 1928 Site Map
- 2 September, 1968 Site Map
- 3 CERCLA 103C Notification
- 4 Notification of Proposed SRAPL Listing
- 5 IAG, KMCC and LIMC Correspondence Concerning  
Voluntary Clean-Up
- 6 Notification of Final SRAPL Listing
- 7 Preliminary Subsurface Investigation, Moss-  
American Inc. Plant Site, East St. Louis,  
Illinois
- 8 A Preliminary Hydrogeologic Investigation in  
the Northern Portion of Dead Creek and  
Vicinity (St. John Report)
- 9 Topographic Survey
- 10 Site Boundary Survey
- 11 Legal Description
- 12 Area Location Map and Surrounding Land Holders
- 13 U.S.G.S. Quadrangle Map
- 14 Potential Location of Underground Piping
- 15 U.S. Department of Health and Human Services  
Memorandum of January 17, 1986

## 1.0 INTRODUCTION

This report concerns the former Moss-American site in Sauget, St. Clair County, Illinois. The site was the location of a creosote and pentachlorophenol (PCP) woodtreating facility. Operations at the facility began in about 1927 when the T. J. Moss Tie Company began wood treatment operations at the 59.6 acre site. In 1963 T. J. Moss sold the facility to the Kerr-McGee Corporation who operated it under their Moss-American Division and subsequently within the Forest Products Division of the Kerr McGee Chemical Corporation (KMCC) until 1969 when the plant was closed. In 1973 KMCC sold 40.1 acres of the original site, including all wood processing and treating areas, to the Lefton Iron and Metal Company (LIMC). KMCC retained ownership of the remaining 19.5 acres which was and currently is utilized for a wood products distribution facility. LIMC purchased the property with the intention of relocating their metal reclamation operation there, but such a move never took place. Since 1973 LIMC has removed a portion of the processing equipment but has not otherwise developed the site for commercial purposes.

In November, 1985 the Illinois Attorney General's (IAG) office notified KMCC and LIMC of potential violations of the Illinois Environmental Protection Act and encouraged KMCC and LIMC to institute a voluntary clean-up. In December 1985 KMCC and LIMC formally agreed to such an IAG supervised clean-up program. Due to the complexity of this program it has been divided into four phases:

- Phase I           Decommissioning
- Phase II         Remedial Investigation Study

- ③ Phase III Remedial Feasibility Study
- ③ Phase IV Remedial Action Implementation

The decommissioning phase includes the removal of all surface improvements. The activities required for that phase are detailed in a report entitled "Decommissioning/Remediation Plan, Former Moss-American Site, Sauget Illinois", which has been submitted to the IAG. This Preliminary Report presents all available historical information and technical data that is pertinent to the preparation of the Phase II Work Plan.



## 2.0 SITE BACKGROUND/EXISTING DATA REVIEW

KMCC/LIMC has conducted a thorough review of all existing information on the site. This has included KMCC, LIMC and IAG file review, interviews with former employees (employed during the 1939 through 1969 time period) and other relevant off-site geological studies. The results of these investigations are presented in the following sub-sections.

### 2.1 Operating History

The T. J. Moss Tie Company began operations in about 1927. Prior to the plant's construction there are no indications that the site was used for industrial purposes. The initial plant included two 6' diameter by 150' long treating cylinders, one coal/wood waste fired boiler, six storage tanks, two surface impoundments, and other associated process equipment. Attachment 1 depicts the facility as it existed in July, 1928.

Additional equipment was added over the operating life of the plant. This included a third 6' diameter by 150' treating cylinder and a natural gas/wood waste fired boiler installed in the early 1950's. Several new material storage, air and vacuum tanks, as well as a variety of wood shaping or preparation mills were also installed at unknown times. A map showing the location of each piece of equipment, as it existed in September, 1968, is shown in Attachment 2. The facility was shutdown in 1969.

Operations at the plant under T. J. Moss and KMCC were essentially identical. The plant utilized the following wood preservatives:

- #1 Grade Creosote
- 50/50 Creosote-Coal Tar Solution
- 60/40 Creosote-Coal Tar Solution
- 70/30 Creosote-Coal Tar Solution
- 80/20 Creosote-Coal Tar Solution
- 50/50 Creosote-Petroleum Solution
- 5% Pentachlorophenol in #2-4 diesel

The creosote and/or creosote solutions were utilized over the entire operating history of the plant. The pentachlorophenol solutions were used only from the early 1950's until the plants closing. No chromated copper arsenate (CCA) or other inorganic salt preservatives were ever utilized.

The following products were manufactured:

- Railroad products, including cross ties and switch ties
- Fence posts
- Utility poles
- Construction piling
- Lumber

The actual volumes of each of these products is unknown. However, in general the plant was operated 12 months per year and five days per week. The production of creosoted products was about 11,000 cubic feet per day based on five charges per day and 2,200 cubic feet per charge. The production rate of pentachlorophenol treated products would average approximately 1,350 cubic feet per day or below one charge per day. The treatment process treated to a retention of seven pounds creosote solution per cubic foot, or 0.4 pounds of dry pentachlorophenol per cubic foot. Based on this, the amount of chemicals used would average approximately 9,700 gallons of

creosote solution per day and 540 pounds of dry pentachlorophenol per day, (or 1,300 gallons of 5% penta solution per day). Assuming the plant treated with creosote for 42 years (1927 through 1969) and PCP for 19 years (1950 through 1969) it would have consumed about 100 million gallons of creosote solution and 1300 tons of dry PCP (or 6.2 million gallons of 5% PCP solution). This assumes the plant was operated 250 working days per year.

The plant utilized air-seasoning for all railroad products, fence posts and lumber. Utility poles and construction piling were seasoned using the open steaming process. The barometric condensor associated with the treatment process used city water for make-up and discharged to the north surface impoundment. Preservatives were routinely recovered from the north impoundment by pumping free product back into the production process. This reportedly occurred on an annual or semi-annual basis as material accumulated. T. J. Moss also dredged heavy sludge from the north impoundment in the early 1960's. This material was placed (and remains to date) on the east bank of the north impoundment.

The history of the site following the discontinuation of operations in 1969 is not totally clear. KMCC retained ownership of the inactive site until it was sold to LIMC in 1973. LIMC reports that the site was frequently vandalized and various items were apparently removed at various times by vandals. To the best of LIMC's present recollection and knowledge, it sold three long, pressure-treating cylinders during the period of approximately 1974 through 1977. One was sold to a broker named Irv Fox; one was sold to Scott Lumber; and one was sold to Turner Lumber. LIMC does not know the final disposition made of these cylinders. In addition, LIMC took up the rail, railroad ties and those railroad switches that had not previously been taken by KMCC, under terms of the

sales agreement, or by vandals. Those items were generally either sold, used or scrapped, depending on their quality.

In addition, LIMC retained an independent contractor named John Patzius in approximately 1981 or 1982 to wreck the buildings and haul away the scrap. Mr. Patzius took down approximately three or four steel buildings, including the boiler room, a quonset hut, and a two-story building. He sold the scrap iron to LIMC. He also cut up a steel railroad car and also sold the scrap to LIMC. In addition, Mr. Patzius cut up one wooden building, and burned some of the wood himself to keep warm while working on the site. He sold approximately four or five tractor trailer loads of coal to the Keisel Coal Company, who brought their own trucks to the site and hauled it away. Mr. Patzius cut down approximately four and one-half storage tanks. He cut each tank in half and then removed any remaining material in the tank bottom into 55-gallon drums, which he had brought onto the site himself. He covered the drums and left them on site. He had attempted to sell the creosote but was unable to do so.

## 2.2 History of Environmental Programs

Throughout the operating history of the site, a variety of wastes or substances were generated and managed. This includes, wood wastes, process wastewater, and stormwater.

### 2.2.1 Process Waste Management

The facility employed several wood shaping operations including a saw mill, adzing and boring mills, framing mill and others. These mills generated a significant amount of wood waste (untreated). These materials were burned in the plant's boiler for heat recovery.

Process wastewaters and a portion of the stormwater were discharged to the plant's treatment system. This system is composed of the two surface impoundments which serve to gravity separate preservatives and to provide retention time in which to naturally biodegrade dissolved constituents. Although crude, this system was reported to have been very effective. Preservatives were routinely recovered from the north surface impoundment and re-used in the treatment process. The clarified water flowed from the north impoundment to the south impoundment. The south impoundment had no discharge and the water, therefore, either evaporated or seeped through the impoundment soils. On rare occasions, it was reported that treated water from the south end of the south impoundment was pumped to the western portion of the tie storage area to prohibit the impoundments from overflowing.

#### 2.2.2 Stormwater Management

Stormwater at the site was managed in two ways; through the wastewater treatment system, or through a seepage sump located near the center of the site. As described in Section 2.2.1, the wastewater treatment system had no outlet for surface water discharge. All accumulated water either evaporated or seeped through the impoundment walls. Similarly, the stormwater that was collected from the remainder of the facility was routed to a seepage sump located near the center of the facility where it seeped into the ground. Through these stormwater management practices, the facility was able to operate without discharging stormwater (or process water) to any off-site surface water body. Although the exact amount of stormwater managed through each of these means is unknown, it has been reported that the majority was routed through the wastewater treatment system.

### 2.3 Regulatory Involvement and History of Response Actions

In June, 1981, KMCC notified USEPA of the existence of the former Moss-American site in accordance with Section 103C of CERCLA requirements (Attachment 3). The notification incorrectly identified the plant's years of operation as 1904 through 1968. This letter is the earliest record involving any environmental matter.

Subsequent to this notification a preliminary IEPA inspection was conducted in May, 1983. This inspection verified the existence of preservative affected materials in surface impoundments and soils (as reported in the 103C notification) and recommended that a more thorough site inspection be performed. In March, 1984, a Field Investigation Team (FIT) conducted an additinoal inspection of the site. Although analytical samples were obtained during this inspection the results were generally inconclusive primarily due to deficiencies in the Quality Assurance/Quality Control procedures.

Based on the results of the inspections, and other information existing at the time, IEPA proposed to list the site on the State Remedial Action Priorities List (SRAPL). Public notice of this proposal was made in the September 27, 1985 Illinois Register (Attachment 4).

On November 5, 1985 IEPA personnel conducted an informal SRAPL inspection and found essentially the same conditions noted earlier. At the same time (November 5, 1985), the IAG's office notified KMCC and LIMC that it intended to proceed with legal action unless they chose to proceed with a voluntary cleanup of the site. KMCC and LIMC representatives confirmed their willingness to participate in such a voluntary cleanup on December 2 and 3, 1985, respectively (Attachment 5).

On February 26, 1986 the site was listed on the Illinois SRAPL. This notification appeared in the March 7, 1986 Illinois Register (Attachment 6).

A second SRAPL inspection was conducted on March 19, 1986. This inspection was attended by IAG, IEPA, KMCC and LIMC representatives. During the inspection a total of nine samples were obtained. Samples were taken of; north impoundment water and sludge; south impoundment water and sludge; water from an open drum near the storage tanks; one of the creosote tank bottoms; two areas of the drip track; and some standing water adjacent to the drip track. These samples were split between IAG/IEPA and KMCC/LIMC personnel.

KMCC/LIMC analyzed for the following parameters; 2-Chlorophenol; 2,4-Dimethylphenol; 2,4-Dinitrophenol; p-Chloro-m-cresol; Pentachlorophenol; 2,4,6-Trichlorophenol; 2,3,4,6-Tetrachlorophenol; Acenaphthylene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Fluoranthene; Indeno(1,2,3-c,d)pyrene; Napthalene; Phenanthrene; Carbazole; and Arsenic. These constituents include every compound selected by EPA as a basis for listing of wastes from the treatment of waste water from creosote and PCP wood treating facilities (K-001, 40 CFR 261, Appendix VII). These parameters were chosen to determine the existence of contamination from the preservatives known to be used at the site and others potentially used (i.e., CCA). The detectable analytical results of the KMCC/LIMC portion appear in Table 1. The results indicate that contamination from preservatives known to be used exists in several areas. The arsenic levels found (in those samples with detectable results) are not indicative of the use of CCA preservatives and appears to confirm the reported non-use of this type of preservative. Review of the soil and product samples data all show moderate to high levels of the polynuclear aromatic hydrocarbons (PAH) indicative of

Table 1  
Analytical Results from the KMCC/LIMC  
Portion of the Field Samples Obtained  
March 19, 1986

<u>Parameter</u>	<u>Soil/Sludge Matrix (mg/kg)</u>					<u>Water Matrix (ug/l)</u>			
	<u>NIS</u>	<u>SIS</u>	<u>CTB</u>	<u>WDT</u>	<u>EDT</u>	<u>NIW</u>	<u>SIW</u>	<u>DW</u>	<u>DIW</u>
2-4, Dimethylphenol	1.250	ND	ND	ND	.109	ND	ND	ND	ND
Phenol	NA	NA	1070.	ND	ND	ND	ND	283	ND
Pentachlorophenol	ND	40.4	ND	9.3	12.5	ND	ND	ND	ND
2,3,4,6, Tetrachlorophenol	35.4	ND	ND	ND	.993	ND	ND	ND	ND
Acenaphthylene	91.	20.9	278.	15.3	4.31	ND	ND		ND
Benzo(a) anthracene	730.	13.9	5340	282.	37.8	ND	ND		ND
Benzo(a) pyrene	695.	33.1	2600.	200.	34.2	ND	ND		ND
Benzo(b) fluoranthene	1880.	135.	5040	707.	122	ND	ND		ND
Dibenzo(a,h) anthracene	192.	ND	ND	54.7	116.	ND	ND		ND
Fluoranthene	3540.	23.2	24400.	835.	1140.	3.79	ND		33.5
Indeno(1,2,3-c,d) pyrene	463.	52.9	995.	151.	33.6	ND	ND		ND
Napthalene	102.	1.8	13900.	66.9	27.2	ND	ND		ND
Phenanthrene	450.	5.45	38000.	229.	76.4	ND	ND		ND
Carbazole	116.	1.83	20400	40.5	6.86	ND	ND		ND
Arsenic	13.	ND	26.	10.	66.	ND	ND	ND	ND

Key: NIS = North Impoundment Sludge  
SIS = South Impoundment Sludge  
CTB = Creosote Tank Bottoms  
WDT = West Drip Track Soil  
EDT = East Drip Track Soil  
NIW = North Impoundment Water

SIW = South Impoundment Water  
DW = Water Phase from a Partially Full Drum  
DIW = Standing Water Adjacent to the Drip Track  
ND = Non Detectable or Below Mean Detection Limit  
NA = Not Analyzed



creosote. Very low levels of contaminants were discovered in any of the four water samples. The low water contaminant levels are to be expected based on the low water solubility and/or high potential for biodegradation associated with creosote and pentachlorophenol constituents. At the time this report was written, the analytical data associated with the IAG/IEPA samples was unavailable.

Two samples of a storage tank insulating material were also obtained by IAG/IEPA personnel and submitted for asbestos analysis during the inspection. The IAG/IEPA results indicate chrysotile at 25 - 50% in one sample and 1 - 5% in the other. However, the laboratory indicated that cross contamination may have occurred since both samples were sent in the same container. It should be noted that asbestos materials have been identified in other KMCC/LIMC obtained samples. The specific results and areas affected appear in the Phase I remediation plan. These materials will be removed in the phase one activities and should be inconsequential to the phase two work.

#### 2.4 Area Geology

Several geological studies have been performed on or near the former Moss-American site. The most significant of these is the "Preliminary Subsurface Investigation, Moss-American, Inc Plant Site, East St. Louis, Illinois" study performed in June, 1968 and "A Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vacinity" (also know as the St. John Report) prepared in April, 1981. These reports appear in Attachments 7 and 8 respectively.

The site is located on the floodplain deposits of the Mississippi River. Jacobs (1971) describes the floodplain deposits as consisting of gravel, sand, silt and clay attaining

thicknesses of up to 120 feet. Typically, the upper 15 to 30 feet is commonly silt and clay with fine sand, representing deposits resulting from the overtopping of the banks of the Mississippi River (Cahokia Alluvium, St. John (1981)). Below 30 feet are found variously sorted sand and gravels evidencing former meander channels (Henry Formation, St. John (1981)). This channel migration and flooding has formed such topographic features as meander scars, oxbow lakes, and swamps. The Woodward-Clyde (1968) report identifies an existing slough representing a possible former channel. St. John (1981) reports that Mississippian limestone underlies the valley deposits.

Groundwater in Sauget is utilized from the sand and gravel deposits that underlie the area. Under pumping conditions, some recharge from the Mississippi River is further, St. John (1981) describes some of the soils underlying the Dead Creek Study area as being oxidized, evidencing recharge from the surface. The water quality is moderately hard to hard as determined by the analyses present by Jacobs (1971).

Groundwater of the plant site is found at shallow depths. St. John (1981) generally shows the depth to the water table at around 15 feet in the Dead Creek Study Area. This may indicate the static conditions existing below the Moss-American site.

The location, completion details, and history of use for all wells in the area surrounding the Moss-American site is unknown. This information should be obtained in the remedial investigation.

### 3.0 NATURE AND EXTENT OF PROBLEM

Based on a review of the information presented in Section 2.0, hazardous or potentially hazardous waste exist in several areas of the facility. These areas include; both surface impoundments; treatment plant area including storage tanks; preservative unloading station; and the drip track. In addition, these materials may exist in the wood storage areas. These wastes are present in the forms of sludges, soils, surface water and potentially contaminated groundwater. No quantitative or specific quantitative results exist at the present time. This information should be obtained in the Remedial Investigation.

The operating history of this facility, in conjunction with the existing analytical database, indicate that creosote/coal tar and pentachlorophenol are the only environmentally significant chemicals present. A discussion of their mobility and their potential for impacting the environment can best be presented individually. This discussion appears in the following sections.

#### 3.1 Composition and Effects of Creosote

Creosote is a distillate of coal tar boiling from about 200 to 400°C (390 to 750°F). Chemically, it is a complex mixture of hundreds of individual PAH\* compounds, plus minor

\* PAH compounds are comprised of carbon and hydrogen in the form of two or more fused aromatic rings. For purposes of this report, the term PAH also includes alkylated PAH compounds and heterocyclic PAH compounds, wherein one or more of the aromatic carbon atoms is replaced by an atom of nitrogen, oxygen or sulfur.

amounts (a few percent) of phenolics. The major PAH constituents (present at concentrations in the range of 2 to 10%) are two, three and four-ring compounds, including naphthalene, acenaphthene, fluorene, anthracene, phenanthrene, fluoranthene, pyrene, and methyl-derivations of these parent compounds. Creosote also may contain trace amounts of higher molecular weight five and six-ring PAH some of which are recognized animal carcinogens and suspected human carcinogens as pure compounds (e.g., benzo(a)pyrene). Table 2 summarizes reported analyses for PAH in creosote which illustrate these points.

Creosote exhibits slight acute and chronic toxicity. Reported LD-50 values are in the range of 0.6 to 0.8 gm/kg for rabbits, dogs and cats and fatal doses for human ingestion have been reported as being approximately 7 grams for adults and 1 to 2 grams for children. Creosote has been identified as being carcinogenic in tests with mice and is a suspected human carcinogen. However, there is no epidemiological evidence of increased cancer risks for creosote plant workers. Moreover, creosote (as well as coal tar) have a long history of various medicinal uses, many of which still continue today.

The occupational exposure standards for coal tar pitch volatiles have been promulgated by OSHA. In addition occupational standards do exist for some of the individual compounds present in creosote such as naphthalene and phenol. Although no EPA published ambient water quality standards exist for creosote this criteria does exist for some PAH compounds (naphthalene, acenaphthene and fluoranthene) and for carcinogenic PAH as a class. The weakness in the standards or criteria for creosote itself in large part reflects the absence of accepted procedures for analyzing creosote per se in air, water or soil. Instead, analysis, and hence standards and criteria - focus on selected chemical constituents of creosote, viz, PAH and phenolics.

Table 2  
Properties of Creosote Constituents

Component	Formula	Water Solubility ppm(c)	Boiling Point, °C	Composition Weight Percent (a)
Naphthalene	C <sub>10</sub> H <sub>8</sub>	30,000	218 (a)	3.0
2-Methylnaphthalene	C <sub>11</sub> H <sub>10</sub>	-	241 (a)	1.2
1-Methylnaphthalene	C <sub>11</sub> H <sub>10</sub>	-	245 (a)	0.9
Biphenyl	C <sub>12</sub> H <sub>10</sub>	-	255 (a)	0.8
Acenaphthene	C <sub>12</sub> H <sub>10</sub>	3.42	279 (a)	9.0
Dimethylnaphthalenes	C <sub>12</sub> H <sub>12</sub>	-	262-269 (b)	2.0
Dibenzofuran	C <sub>12</sub> H <sub>8</sub> O	-	287 (a)	5.0
Carbazole	C <sub>12</sub> H <sub>9</sub> N	-	355 (a)	2.0
Fluorene	C <sub>13</sub> H <sub>10</sub>	1.69	297 (b)	10.0
Methylfluorenes	C <sub>14</sub> H <sub>12</sub>	-	318 (a)	3.0
Phenanthrene	C <sub>14</sub> H <sub>10</sub>	1.00	340 (a)	21.0
Anthracene	C <sub>14</sub> H <sub>10</sub>	.045	340 (a)	2.0
Methylphenanthrenes	C <sub>15</sub> H <sub>12</sub>	-	354-355 (a)	3.0
Methylanthracenes	C <sub>15</sub> H <sub>12</sub>	-	360 (a)	4.0
Fluoranthene	C <sub>16</sub> H <sub>10</sub>	.206	382 (a)	10.0
Pyrene	C <sub>16</sub> H <sub>10</sub>	.132	393 (a)	8.5
Benzofluorenes	C <sub>17</sub> H <sub>12</sub>	-	413 (a)	2.0
Chrysene	C <sub>18</sub> H <sub>12</sub>	.0018	448 (a)	3.0
Benz (a) anthracene	C <sub>18</sub> H <sub>12</sub>	.0057	438 (b)	-
Benz (j) fluoranthene	C <sub>20</sub> H <sub>12</sub>	-	~480 (b)	-
Benz (k) fluoranthene	C <sub>20</sub> H <sub>12</sub>	.0043	480 (b)	-
Benz (a) pyrene	C <sub>20</sub> H <sub>12</sub>	.0012	496 (b)	-
Benz (e) pyrene	C <sub>20</sub> H <sub>12</sub>	-	493 (b)	-
Perylene	C <sub>20</sub> H <sub>12</sub>	-	~460 (b)	-
Benzo (b) chrysene	C <sub>22</sub> H <sub>14</sub>	-	~500 (b)	-
Phenol	C <sub>6</sub> H <sub>5</sub> O <sub>4</sub>	93,000	181	-
			Total	90.4

- (a) Lorenz, L.F. and L.R. Gjovik. 1972 Analyzing Creosote by Gas Chromatography: Relationship to Creosote Specifications. Proceedings of the American Wood Preservers Association 68:32-42
- (b) Anderson, H.C. and W.R.K. Ws. 1963. Properties of Compounds in Coal-Carbonization Products. U.S. Bureau of Mines Bulletin 606.
- (c) Draft Superfund Public Health Evaluation Manual, USEPA December, 1985

### 3.2 Behavior of Creosote Constituents

PAH are very stable compounds that are distributed throughout the environment as a result of both natural and man-made processes. The origin, distribution and behavior of PAH in the environment has been studied extensively and background levels are detectable in any environmental media in virtually any location if sufficiently powerful analytical techniques are used.

PAH exhibit low volatility and low aqueous solubility, as noted in Table 2. Both of these properties decrease exponentially as molecular size increases. Compounds containing four or more fused rings generally have aqueous solubilities below about 10 ug/l. Because of their hydrophobic characteristics, as evidenced by the low aqueous solubilities, PAH exhibit a strong tendency to adsorb on soils and sediments. Such adsorption often plays a major role in the environmental fate and transport of PAH. The adsorption tendencies of PAH are inversely related to solubility, and hence increase exponentially with increasing molecular size. PAH compounds are also biodegradable by a variety of naturally occurring microorganisms, with biodegradation generally being more difficult for higher molecular weight compounds.

The major concern among the potential impacts of PAH is that certain PAH compounds are well-known animal carcinogens and are suspected human carcinogens (benzo(a)pyrene is the classic example). A relatively small proportion of the many hundreds of different PAH compounds are carcinogenic and these are usually higher molecular weight compounds containing 4 to 6 fused aromatic rings. Non-carcinogenic PAH exhibit relatively low toxicity, so the human health concerns for PAH as a class focus on the carcinogenic compounds.

PAH have only moderate toxic effects on aquatic and terrestrial plants and animals. Relatively high concentrations compared to natural background levels, are required to elicit significant toxic responses. Bioconcentration is typically not a concern, since PAH are metabolically degraded and excreted readily.

Phenolics are also widely distributed in the environment as a result of both natural and man-made processes. They are highly soluble in water (well over 10,000 mg/l) but have very low vapor pressures and low adsorption tendencies. Phenolics are readily biodegraded by a variety of microorganisms, with biodegradation half-lives on the order of days not uncommon. As a result of these properties, the fate of phenolics in soil horizons is dominated by biodegradation.

The primary health hazard associated with phenolics is acute poisoning. They exhibit moderate toxic effects on aquatic organisms. Bioaccumulation of phenolics is also not a concern. The widely applied water quality criterion of 1 ug/l for phenolics is based on preventing objectionable odors in water supplies (from chlorinated phenols resulting from water chlorination) or tainting of fish flesh.

### 3.3 Composition and Effects of Pentachlorophenol

Pentachlorophenol (PCP) used in the wood treating industry is predominantly produced by the direct chlorination of phenol. The alternative method of manufacture is the hydrolysis of hexachlorobenzene. However, no known manufacturer exists within the United States utilizing this mechanism.

The composition of PCP produced via direct chlorination of phenols depends on reaction conditions, and the purity of feedstocks.

The most significant contaminants found in U.S. made PCP, listed in the order of decreasing concentration levels, are tetra, tri, di and monochlorophenols. These result from the incomplete chlorination of the phenol molecule due to insufficient available chlorine, reaction time, pressure, or temperature. Since the chlorination of phenol is an ortho (o), para (p) directed reaction the predominant products are substituted in these positions. The meta (m) position is typically substituted to a much lower degree unless the o and p positions have already been substituted. The concentration of tetra and trichlorophenols in commercial PCP can be significant.

The use of impure feedstocks is represented from the presence of trace amounts of benzene, and methyl phenol (o, m and p cresols) in commercial phenol. The chlorination of these compounds results in the presence of higher chlorobenzenes and chloro cresols. Due to the low concentrations of these compounds (if detectable) in PCP and the low concentration of PCP solutions used in wood treating facilities (typically 1 to 5%) these compounds are rarely detected in PCP wood treating sites. Based on this fact EPA has recognized that the presence of these compounds is not environmentally significant by not referencing them as a criteria for listing K-001 wastes.

PCP has been shown to be toxic to man and animals with the lowest lethal oral dose to man reported at 29 mg/kg. Reported lethal doses to rats vary from 11.7 to 320 mg/kg. Non-fatal acute exposure of PCP to man can result in; skin, nasal, eye and respiratory tract irritation; headache, abdominal pain, fever and fatigue. Prolonged ingestion of 100 - 500 mg/kg has been shown to produce liver damage in rats. Daily ingestion of 30 mg/kg can also be fetotoxic and teratogenic to rats during gestation.



### 3.4 Behavior of Pentachlorophenol

Table 3 summarizes the properties of PCP and its significant impurities. As with the constituents of creosote PCP is characterized by slight water solubility and very low vapor pressure. This low solubility indicates a highly lipophilic material which will exhibit a strong tendency to adsorb on soils and sediments. This adsorption will play a major role in the environmental fate and transport of PCP.

Biodegradation and photolysis are the major processes affecting the fate of PCP. PCP is biodegradable in moderate concentrations with degradation proceeding rapidly under optimal conditions. This degradation rate will depend on the levels of oxygen, macro and micro nutrients, and interfering toxic elements or compounds. When exposed to sunlight, PCP will photolyze rapidly forming less chlorinated phenols, anisoles and other compounds. This mechanism can be significant in the evaluation of surface water runoff.

Table 3  
Properties of Pentachlorophenol and  
its Major Impurities

<u>Component</u>	<u>Formula</u>	<u>Aqueous Solubility (mg/l)</u>	<u>Vapor Pressure mmHg</u>
Pentachlorophenol	$C_6Cl_5OH$	14.	$1.1 \times 10^{-4}$
2,3,4,6 Tetrachlorophenol	$C_6HCl_4OH$	1000.	-
2,4,6 Trichlorophenol	$C_6H_2Cl_3OH$	800	.012

#### 4.0 PATHWAYS OF EXPOSURE

There are four potential routes for exposure of hazardous constituents from the site. They are direct contact, air migration, surface water migration and groundwater migration.

##### 4.1 Direct Contact

The first area of potential impacts is the direct contact with contaminated soils, including ingestion. Such exposure potential probably will not result in adverse health effects from wastes at the Moss-American site for a variety of reasons. The primary reason is that public access to the site is controlled by a three strand barbed wire fence and locked gate. In addition, creosote and PCP exhibit relatively mild acute toxicity. For example, over 1 pound of contaminated soil containing 1 percent creosote or 1000 ppm PCP would need to be ingested to produce a fatal dose for an adult.

##### 4.2 Air Migration

The second exposure route considered is through the inhalation of constituents volatilized from contaminated soils. This exposure potential needs to be accessed and quantified by calculating worst-case emission rates and the resulting ambient air concentration for naphthalene, the most volatile compound expected to be found in the waste. A variety of emission rate models are available from the open literature for performing these evaluations. In addition inhalation of waste constituents may also occur via exposure to dust containing particulate adsorbed PAH or PCP.

Although the application of these models to wastes specific to the Moss-American site has not been performed to date, similar calculations have been performed on wastes at

sites having similar contaminants. The results typically indicate that the air migration of hazardous constituents via volatilization and dust transport are not a significant threat to human health or the environment.

#### 4.3 Stormwater Runoff

The concentration of contaminants in the surface runoff is a function of the soil concentration in contact with the runoff. At equilibrium, this relationship is defined by the partition coefficient,  $K_p$  as:

$$K_p = \frac{C_s}{C_w}$$

where  $C_s$  is the contaminant concentration in the soil and  $C_w$  is the equilibrium contaminant concentration in the runoff water. The partition coefficient is a measure of the tendency of organic compounds to adsorb to soil.

Adsorption has been shown to vary with the organic content of the soil in question. A more commonly used means to quantify adsorption is the partition coefficient expressed per fractional organic content:

$$K_{oc} = K_p / oc$$

where  $oc$  is the fractional mass of organic carbon in the soil.

Table 4 lists literature values of  $K_{oc}$  for compounds expected to be representative of the waste.

Table 4  
 $K_{OC}$  Fractional Organic Partition Coefficient Values  
 (ml/g)

<u>Compound</u>	<u><math>K_{OC}</math> Value</u>
Naphthalene	1,300 (a)
Anthracene	26,000 (a)
Phenanthrene	23,000 (a)
Pyrene	84,000 (a)
Benzo(a)pyrene	$5.5 \times 10^5$ (b)
Pentachlorophenol	53,000 (b)

Notes:

- (a) Karickhoff, S.W., D.S. Brown and T.A. Scott, 1979. Sorption of Hydrophobic Pollutants on Natural Sediments. Water Res. 13: 241
- (b) Draft Superfund Public Health Evaluation Manual, USEPA, December 1985.

The concentration calculated via partition coefficient calculations implicitly assume steady-state conditions with an infinite source-term. In actual fact, the source-terms are finite and the sources will eventually disappear by means of (1) leaching all of the reversibly adsorbed contaminants out of the soils and 2) biodegradation of the contaminants. Leaching of contaminants is a mass transfer function and is related to the solubility of constituents in contact with water. As discussed earlier the compounds present in creosote and PCP exert low solubilities. Further, leaching may be limited by the migration of constituents within a soil or sludge particle to the surface exposed to water. This migration is controlled by the concentration gradient and mobility of a particular compound within specific soil or sludge matrices. This mobility will decrease with decreasing temperature to the point that at ambient temperatures the mobility will be low and potentially the limiting factor in mass transfer. The leaching process for creosote and PCP wastes is, therefore, very slow and can take a number of years to complete. Alternately, biodegradation will remove the soil contaminants and their contribution to runoff water contamination relatively rapidly. This is illustrated by Table 5, which shows how the predicted PAH and PCP concentrations in the total runoff will decrease as the contaminants are biodegraded. The table indicates that contaminant concentration in runoff surface water could be reduced by multiple orders of magnitude in as little as a year, with individual compound concentrations typically being reduced to well below 1 ug/l.

The biodegradation rates shown in Table 5 should not be considered predictions applicable to the specific contaminated soils at the Moss-American site. Actual biodegradation rates will vary due to a variety of factors. It is well-established,

Table 5  
Long Term Runoff Concentrations  
Accounting for the Effect of Biodegradation

<u>Compound</u>	Biodegradation Half-Life, <u>Days</u>	<u>Fraction of Initial Runoff Concentration</u>	
		<u>After 1 Year</u>	<u>After 2 Years</u>
Naphthalene	125(a)	.13	$1.7 \times 10^{-2}$
Anthracene	42(a)	$2.6 \times 10^{-3}$	$6.2 \times 10^{-6}$
Phenanthrene	26(b)	$6.1 \times 10^{-5}$	$2.5 \times 10^{-9}$
Pyrene	35(b)	$7.3 \times 10^{-4}$	$2.9 \times 10^{-7}$
Benzo(a)pyrene	92(a)	$6.4 \times 10^{-2}$	$4.1 \times 10^{-3}$
Pentachlorophenol	5(c)	$1.1 \times 10^{-22}$	$1.1 \times 10^{-44}$

Notes:

- (a) Sims, R.C. 1982. Land Treatment of Polynuclear Aromatic Compounds. PhD Dissertation. Dept. Biol. Agr. Engr. NC State Univ., Raleigh, NC.
- (b) Groenewegan, D. and H. Stolp. 1972. Microbial Breakdown of Polycyclic Aromatic Hydrocarbons. Tbl. Bakt. Hyg. I. Abt.: Orig. B162, 225.
- (c) Draft Superfund Public Health Evaluation Manual, USEPA, December, 1985.

however, that creosote and PCP constituents will biodegrade under a wide range of concentrations and environmental conditions.

#### 4.4 Groundwater Impacts

Based on the assumption of contaminant equilibrium between soil and water, leachates from contaminated soils that infiltrate the groundwater table will be of the same quality as that for surface water runoff. However, unlike surface water impacts, the effects of PAH-contaminated leachates will not be evidenced in the groundwater for many years. This is due to the relatively slow movement at groundwater and, in addition, the transport of PAH in groundwater is slowed even further by adsorption/desorption effects.

A common model for the retardation of contaminant transport in groundwater resulting from adsorption on the aquifer matrix is;

$$R_d = \frac{v}{v_c} = 1 + \frac{P_b}{n} K_p$$

where  $R_d$  is the retardation factor, defined as the ratio of the average linear groundwater velocity ( $v$ ) and the velocity of the 50% point in the concentration profile of the retarded contaminant ( $v_c$ ),  $P_b$  is the bulk mass density of the aquifer material,  $n$  is the aquifer porosity, and  $K_p$  is the partition coefficient.

Table 6 shows retardation factors for selected creosote and PCP constituents calculated using a  $P_b/n$  value of  $4 \text{ gm/cm}^3$  (lower bound of likely values) and the  $K_{oc}$  literature values given in Table 4. Retardation factors are shown for two assumed organic carbon values, 1.0% and 0.10%.



Table 6

Retardation Factors (Rd) for Transport  
in Groundwater

<u>Compound</u>	<u>Organic Carbon Content = 1.0%</u>	<u>Organic Carbon Content = .1%</u>
Naphthalene	52	6.2
Anthracene	1030	100.
Phenanthrene	920	93.
Pyrene	3400	300.
Benzo(a)pyrene	180,000	18,000.
Pentachlorophenol	2100	210.

Although - groundwater velocities present at the Moss-American site are not known at this time, typical values to be expected in geology of this type would be 1 to 10 ft per year.

When combined with the retardation factors shown in Table 6, this indicates that most PAH contaminants are likely to take many decades to reach the Moss-American property boundary. In actual fact, given the relatively rapid biodegradation for PAH and PCP in contaminated soils and water, there is a possibility that on-site contamination will have negligible impact on the quality of the groundwater downgradient from the Moss-American site.

The most significant concern for the subsurface migration of creosote is its movement as a free product. Creosote has a specific gravity somewhat higher than water and, therefore, tends to move readily through high permeability soils until a confining strata is encountered, at which point it tends to pool and migrate along the surface of the confining layer. This phenomenon generally results from a large source, such as the surface impoundments at the site. This possibility should be investigated in the RI field study.

## 5.0 SITE MAP/INVESTIGATIVE SUPPORT

### 5.1 Topographic Map

Attachment 9 depicts a topographic survey of the facility as it existed August 1986. This map locates of all existing prominent structures and equipment. For comparison purposes Attachment 1 depicts the facility as it existed in July 1928 and Attachment 2 as of September 1968.

### 5.2 Site Survey

Attachment 10 represents the results of a boundary survey conducted in January, 1986. Attachment 11 contains a legal description of the facility.

### 5.3 Surrounding Land Owners

Attachment 12 shows an area location map showing the plant and the land surrounding it for a distance of 2000 feet. This off-site land area has been divided into sub-groups and a listing of the land holders within each sub-group also appears in Attachment 12.

### 5.4 U.S.G.S. Quadrangle Map

Attachment 13 contains the 7.5 minute United States Geological Survey Map for the Cahokia, Ill-Mo quadrangle. Designation of the plant site appears on this map.

## 5.5 Sub-Surface Piping

Although the precise location of all subsurface piping is unknown, Attachment 14 shows the potentially existent underground piping. The exact location of this, and any other, subsurface piping will be determined in the remedial investigation.

## 6.0 POTENTIAL REMEDIAL ACTIONS

Based on information from the preliminary site inspections three different waste categories are expected to be encountered in the RI:

<u>Category</u>	<u>Description</u>
Sludge	High organic content wastes (typically above 10 percent oil and grease). This sludge will consist of tank bottoms, drum contents, some surface impoundment sludges, and possibly some highly contaminated soils from the process and drip track areas.
Contaminated Soils	Low organic content wastes (typically below 10 percent oil and grease). This category will include most process and drip track area soils, some surface impoundment sludges and all sub-soils, and soils discovered in other isolated areas.
Contaminated Water	This will include both surface impoundment water as well as any contaminated groundwater.

Potential remedial actions applicable for each of these waste categories are discussed in the following sections.

## 6.1 Sludges

Five types of remedial action alternatives are viable for highly contaminated sludges: 1) Recovery, 2) Biological Degradation, 3) Incineration, 4) Disposal and 5) No Action.

Based upon KMCC and ERT's experience with similar sites, and the facilities own documented practice, recovery appears to be the most viable sludge remediation method. Although there is a variety of recovery methods available they all rely upon viscosity reduction (heating, solvent addition etc.), filtration (screening, filter press, belt filter, vacuum filter, etc) and separation of the inorganic and organic phases (conventional gravity, etc). The organic phase recovered can generally be used directly in a local creosote wood treating facility. The solid and water phases would be managed as discussed in Sections 6.2 and 6.3, respectively.

The most promising alternative to recovery is biological degradation. In practical application this can take the form of an activated sludge reactor (similar in principle to a typical municipal wastewater treatment plant) or land treatment. In both cases, creosote PAH's and pentachlorophenol have been successfully degraded or immobilized on a full scale basis. Very high destruction efficiencies can be expected for the two, three and some four ring PAH compounds and PCP. Although somewhat lower destruction efficiencies are reported for the higher PAH molecular weight compounds, these compounds are characterized by very low aqueous solubilities (typically below 10 ppb) and very high adsorptive properties. For practical purposes, these compounds are immobile and, therefore, environmentally insignificant from an aqueous migration standpoint.

The intermediate biological degradation products for creosote and PCP are carboxylic acids with the final products

being carbon dioxide, water, and hydrochloric acid (typically neutralized in situ).

Activated sludge reactors are typified by high degradation rates, thorough waste distribution, low land requirements and a high degree of operating parameter control. Alternately, they require careful monitoring, have higher operating costs and have substantial mixing requirements when soils are treated. This mixing requirement can be technically limiting.

Land treatment units require minimal monitoring, have low operating costs, and are not as susceptible to equipment malfunctions or limitations. Their disadvantages include slower degradation rates, difficulty in obtaining an even waste distribution, high land requirements, and their susceptibility to upsets due to a variety of climatic conditions (rain, temperature, etc.).

Incineration most commonly involves rotary kiln incineration but can include fluidized bed or infrared incineration. Although this alternative is very expensive it will yield a permanent solution to the relatively small amount of the high contaminant level sludge type waste.

Disposal is the fourth option available and can take place either on-site or off-site. In either case the chosen landfill may be required to meet construction and monitoring standards for hazardous waste disposal facilities. For low viscosity sludges (liquids), solidification via a lime-silicate pozzolonic reaction should also be evaluated. Although somewhat more expensive encapsulation of the waste may be desired prior to disposal. Encapsulation would reduce the mobility of hazardous waste constituents.

The in-situ disposal option is also available. In this case an impermeable barrier (slurry wall, grout curtain etc.) would be installed around the perimeter of the existing waste areas. This barrier would have to be keyed into the first

regionally extensive aquaclude. Based on an evaluation of existing geological reports this formation may be a limestone deposit located at a depth of 100-115 feet below grade. This may preclude the technical feasibility and economic attractiveness of this alternative. In addition this type of disposal area would be required to be capped with an impermeable substance and graded to prohibit the infiltration of rain or surface water.

Should the results of the RI/FS determine that negligible additional risk to human health or the environment is presented by this waste, no remedial action may be required. This alternative will be evaluated for environmental benefit and cost comparative purposes.

Based on the information currently available the recovery option should be investigated to the greatest depth. This option would provide a permanent remediation to the most highly concentrated wastes while conserving natural resources.

## 6.2 Soils

Low organic content wastes have essentially the identical disposition options technically available as high organic content sludge wastes. However, based on the relative contamination levels and expected larger volumes the recovery and incineration options will undoubtedly not be as attractive from environmental, technical feasibility and economic considerations.

The PAH's and PCP's associated with this waste have been shown to have low aqueous solubility, to be irreversibly adsorbed to soils (partially) and to be naturally biodegraded. Dependent on the results of the RI/FS, a cut-off level will undoubtedly be determined where soils affected below this level are deemed to be environmentally insignificant and can safely



be dealt with via the no-action alternative. The U.S. Department of Health and Human Services has set such a limit at 100 ppm for surficial soil in a residential setting for an otherwise similar wood treating site within Region VI. This reference appears in Attachment 15.

In view of the relatively minor risk posed to human health or the environment by these low contamination level, low mobility materials some type of biological degradation may prove to be the most effective for soils falling below the sludge level but above the no action cut-off level. This alternative should therefore be evaluated in the greatest detail during the RI/FS activities. A discussion of the various options available under the biological degradation option appears in Section 6.1.

### 6.3 Water

Although all surface and groundwater analysis obtained to date show low to non-detectable levels of contamination. Some type of water remediation may be required.

Although a variety of water remediation alternatives are available, virtually all will require an initial crude organic-water phase separator. This separator may have to be designed to separate lighter than water organics (most petroleum products) as well as heavier than water organics (creosote/coal tar products).

Following the initial organic-water phase separation, three types of remedial alternatives are applicable: 1) biological oxidation and 2) activated carbon adsorption, and 3) chemical oxidation.

Biological oxidation can take place off-site at a local sanitary wastewater treatment plant or on-site via either a

similar activated sludge process or for use as irrigation water for a land treatment process. Descriptions of these processes appear in Section 6.1.

The most feasible alternative to biodegradation is activated carbon adsorption. Although the alternative will typically yield the highest removal rate, this additional removal efficiency is rarely needed for environmental reasons and typically cannot be justified on a cost benefit basis. This treatment would most probably take place on-site.

An additional alternative to water remediation is chemical oxidation. This typically would be accomplished by the use of ozone. Ozone's primary advantage is that it can readily be manufactured on site utilizing electrically driven generators that do not require highly trained supervision. Its main disadvantage is high cost. If a relatively small amount of low contamination water is to be remediated, this alternative may, however, be cost effective.

The final alternative is no action. For groundwater this may be selected because no usable aquifer has been affected or potentially because downgradient impacts are much more significant than the impact from the Moss-American site and prohibit the useful utilization of the aquifer.

If an on-site biological degradation system is chosen for remediation of sludges or soils, wastewater can most appropriately be utilized for make-up or irrigation purposes. Otherwise, the possibility of discharging this water to a municipal or industrial sanitary wastewater treatment plant should be evaluated. As a final alternative an activated carbon treatment system or chemical oxidation system should be investigated.

**ATTACHMENT 3**  
**CERCLA 103C Notification**

RETURN RECEIPT REQUESTED

U. S. EPA, Region 5  
Sites Notification  
Chicago, IL 60604

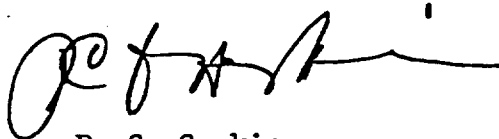
RE: Notification of Hazardous Waste Site  
Kerr-McGee Chemical Corporation  
E. St. Louis, IL, and Milwaukee, WI,  
Facilities

Gentlemen:

Enclosed is the completed Notification of Hazardous Waste Site Form for  
the Kerr-McGee E. St. Louis, IL, and Milwaukee, WI, facilities.

Very truly yours,

KERR-MCGEE CHEMICAL CORPORATION  
FOREST PRODUCTS DIVISION



P. C. Gaskin  
Environmental & Quality Control

PCG:jw  
Enclosures

**F Waste Quantity:**  
Place an X in the appropriate boxes to indicate the facility types and at the site.

In the "total facility waste amount" space give the estimated combined quantity (volume) of hazardous wastes at the site using cubic feet or gallons.

In the "total facility area" space, give the estimated area size which the facilities occupy using square feet or acres.

**Facility Type:**

1. ☒ Piles
2. ☐ Land Treatment
3. ☐ Landfill
4. ☐ Tanks
5. ☒ Impoundment
6. ☐ Underground Injection
7. ☐ Drums, Above Ground
8. ☐ Drums, Below Ground
9. ☐ Other (Specify) \_\_\_\_\_

**Total Facility Waste Amount**

cubic 311,000 C

gallons \_\_\_\_\_

**Total Facility Area**

square feet 85,300 S

acres \_\_\_\_\_

**G Known, Suspected or Likely Releases to the Environment:**

Place an X in the appropriate boxes to indicate any known, suspected, or likely releases of wastes to the environment.

☐ Known ☐ Suspected ☐ Likely ☒ Other

Note: Items Hand I are optional. Completing these items will assist EPA and State and local governments in locating and assessing hazardous waste sites. Although completing the items is not required, you are encouraged to do so.

**H Sketch Map of Site Location: (Optional)**

Sketch a map showing streets, highways, routes or other prominent landmarks near the site. Place an X on the map to indicate the site location. Draw an arrow showing the direction north. You may substitute a publishing map showing the site location.

**I Description of Site: (Optional)**

Describe the history and present conditions of the site. Give directions to the site and describe any nearby wells, springs, lakes, or housing. Include such information as how waste was disposed and where the waste came from. Provide any other information or comments which may help describe the site conditions.

**J Signature and Title:**

The person or authorized representative (such as plant managers, superintendents, trustees or attorneys) of persons required to notify must sign the form and provide a mailing address (if different than address in item A). For other persons providing notification, the signature is optional. Check the boxes which best describe the relationship to the site of the person required to notify. If you are not required

Name P. C. Gaskin

Street Kerr-McGee Chemical Corp.

City Okla. City, State OK Zip Code 73125

Signature P. C. Gaskin

Date 6/8/81

- ☐ Owner, P.  
☒ Owner, P.  
☐ Transport  
☐ Operator  
☒ Operator  
☐ Other

This initial notification information is required by Section 103(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and must be filed by June 9, 1981.

Please type or print in ink. If you need additional space, use separate sheets of paper. Indicate the letter of the item which applies. 810609

II #282

ILS-000-001-219

**Person Required to Notify:**

Enter the name and address of the person or organization required to notify.

Name Kerr-McGee Chemical Corporation

Street P. O. Box 25861 Room 1203

City Oklahoma City State OK Zip Code 73125

**Site Location:**

Enter the common name (if known) and actual location of the site.

Name of Site Moss-American, Inc. (E. St. Louis Plant)

Street So. 20th Street and Falling Springs Road

City Centerville TWP St. Clair State IL Zip Code 62821 None

ILD980607493

**Person to Contact:**

Enter the name, title (if applicable), and business telephone number of the person to contact regarding information submitted on this form.

Name (Last, First and Title) Gaskin, P. C., Environmental Control

Phone (405) 270-2395

**Dates of Waste Handling:**

Enter the years that you estimate waste treatment, storage, or disposal began and ended at the site.

From (Year) 1904 To (Year) 1968

**Waste Type: Choose the option you prefer to complete**

**Option 1:** Select general waste types and source categories. If you do not know the general waste types or sources, you are encouraged to describe the site in Item 1—Description of Site.

**General Type of Waste:**  
Place an X in the appropriate boxes. The categories listed overlap. Check each applicable category.

- 1. ☐ Organics
- 2. ☐ Inorganics
- 3. ☐ Solvents
- 4. ☐ Pesticides
- 5. ☐ Heavy metals
- 6. ☐ Acids
- 7. ☐ Bases
- 8. ☐ PCBs
- 9. ☐ Mixed Municipal Waste
- 10. ☐ Unknown
- 11. ☐ Other (Specify)

**Source of Waste:**  
Place an X in the appropriate boxes.

- 1. ☐ Mining
- 2. ☐ Construction
- 3. ☐ Textiles
- 4. ☐ Fertilizer
- 5. ☐ Paper/Printing
- 6. ☐ Leather Tanning
- 7. ☐ Iron/Steel Foundry
- 8. ☐ Chemical, General
- 9. ☐ Plating/Polishing
- 10. ☐ Military/Ammunition
- 11. ☐ Electrical Conductors
- 12. ☐ Transformers
- 13. ☐ Utility Companies
- 14. ☐ Sanitary/Refuse
- 15. ☐ Photofinish
- 16. ☐ Lab/Hospital
- 17. ☐ Unknown
- 18. ☐ Other (Specify)

**Option 2:** This option is available to persons familiar with the Resource Conservation and Recovery Act (RCRA) Section 300 regulations (40 CFR Part 261).

**Specific Type of Waste:**  
EPA has assigned a four-digit number to each hazardous waste listed in the regulations under Section 3001 of RCRA. Enter appropriate four-digit number in the boxes provided. A copy of the list of hazardous wastes and codes can be obtained by contacting the EPA Region serving the State in which the waste is located.

K001



**ATTACHMENT 4**  
**Notification of Proposed SRAPL Listing**



Illinois Environmental Protection Agency

2200 Churchill Road, Springfield, IL 62706

217/782-6760

Refer to: L1631210014 -- St. Clair County  
Moss American  
Superfund/General

September 26, 1985

Robert Goddard  
Lefton Iron and Metal  
205 South 17th  
East St. Louis, Illinois 62207

Pete Gaskin  
Kerr-McGee Chemical Corporation  
P.O. Box 25861, Room 1202  
Oklahoma City, Oklahoma 73125

Gentlemen:

As an owner/operator of the facility indicated in the above heading, you are hereby notified that your facility is listed on the proposed State Remedial Action Priorities List (SRAPL) which is being published in the Illinois Register on September 27, 1985. The purpose of the SRAPL is primarily to serve as an informational tool for use by the Agency in identifying sites that appear to present a significant risk to public health, welfare and/or the environment.

The initial identification of a site on the SRAPL is intended to guide the Agency in determining which sites warrant further investigations designed to assess the nature and extent of the risks associated with your site. These investigations will determine what State-financed remedial action, if any, may be appropriate.

Enclosed is a copy of the proposed rule including the SRAPL. If you have any questions regarding the SRAPL, don't hesitate to contact this office.

Sincerely,

James F. Frank, Manager  
Hazardous Substance Control Section  
Division of Land Pollution Control

JFF:MM:rd2085E/6

Enclosure

cc: DLPC File  
DLPC Regional Office



**ATTACHMENT 5**  
**IAG, KMCC and LIMC Correspondence**  
**Concerning Voluntary Cleanup**



NEIL F. HARTIGAN  
ATTORNEY GENERAL  
STATE OF ILLINOIS  
SPRINGFIELD  
62706

November 5, 1985

Ms. Carolyn Hill  
Division Counsel  
Kerr McGee Center  
P.O. Box 25861  
Oklahoma City, OK 23125

J. L. Rainey  
President  
Kerr McGee Chemical Corp.  
P.O. Box 25861  
Oklahoma City, OK 23125

Re: Moss American, Inc.

Dear Ms. Hill and Mr. Rainey:

This letter confirms our conversation this date regarding the environmental problems at the former Moss American site in Sauget, Illinois.

This office has recently conducted an investigation into potential environmental violations at the Moss American site in Sauget, Illinois. The investigation has revealed serious environmental violations at the site regarding improper dumping, storage, and disposal of both hazardous and nonhazardous wastes. Specifically, creosote and creosote wastes have been improperly dumped, stored, and disposed of in on-site waste piles, and leaking and overflowing tanks and drums. The wastes have in the past and continued to the present to flow freely upon the land and into the on-site surface and groundwater. The entire delapidated site is highly contaminated with hazardous wastes. Furthermore, the site is left unguarded and is easily accessible to the neighboring residents and to local wildlife; there is no fence around the site, nor are there any warning signs posted. In sum, the present condition of the site violates numerous sections of the Illinois Environmental Protection Act, and constitutes a public nuisance.

This office has prepared a multi-count complaint alleging numerous violations of the Illinois Environmental Protection Act and nuisance; the suit names as defendants former owners, Moss American and Kerr McGee, and present owner, Lefton Iron and Metal Company. The suit is prepared for immediate filing. However, as a courtesy, this office is willing to offer responsible parties an opportunity to voluntarily accept responsibility and voluntarily undertake actions necessary to begin remediation of the problems prior to the filing of an action. Therefore, this letter serves as formal notice that a

lawsuit will be filed against Kerr McGee, Moss American, and Lefton Iron and Metal. The timing of the filing of that lawsuit will depend on the level of cooperation, if any, voluntarily undertaken by the defendants. This office stands willing to work together with defendants towards a voluntary and acceptable cleanup plan.

At a minimum, this office expects the defendants to accept immediate responsibility for the problem, and take immediate measures to remedy it, including the installation of a fence around the site, the posting of warning signs, and the taking of immediate measures designed to halt the ongoing flow of hazardous waste onto the ground and into the water at the site. In addition to immediate remedial measures, the defendants are expected to undertake at their expense long-term cleanup of the site, beginning with a comprehensive remedial investigation and feasibility study (RI/FS) and contamination assessment plan, and culminating in the implementation of remedial action and removal plan.

This office expects and appreciates the defendants' cooperation in addressing this problem in an environmentally sound manner. Therefore, please notify this office in writing by December 7, 1985 regarding the willingness of Kerr McGee and Moss American to voluntarily accept responsibility and initiate cleanup. If the defendants do not agree to take voluntary action within that time, the lawsuit will be filed. I look forward to your prompt attention to this matter.

If you have any questions, comments or suggestions, please feel free to contact me. Thank you in advance for your cooperation and consideration.

Very truly yours,



Mark A. LaRose  
Assistant Attorney General  
Environmental Control Division

MAL:csn

EXPRESS MAIL



December 2, 1985

Mark A. LaRose, Esq.  
Assistant Attorney General  
Environmental Control Division  
State of Illinois  
500 South Second Street  
Springfield, IL 62706

Re: Sauget, Illinois site

Dear Mr. LaRose:

This is in response to your letters of November 5 and 25, and to confirm our joint telephone conference with Maxine I. Lipeles, Esq., attorney for Lefton Iron and Metal Company, Thursday afternoon, November 21st.

Kerr-McGee is obtaining bids for the immediate installation of a six-foot chain link fence with three strand barbed wire cap, around three quarters of the perimeter of the property belonging to Lefton Iron and Metal Company in Sauget, Illinois. The west boundary has an adequate existing fence of similar design. Signs will be posted at reasonable intervals around the perimeter, which say, "DANGER, DO NOT ENTER".

In addition, Kerr-McGee is also going to provide technical expertise in the form of qualified environmental personnel who are Kerr-McGee employees to assist Mr. Lefton in cleaning up the surface of the property and reducing the visual contamination.

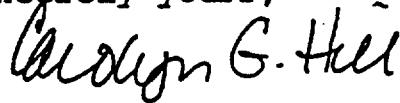
We appreciate your sending copies of the USEPA's 1984 chemical analysis of the site. Further sampling will be done to determine better what is on the premises. As agreed, any cleanup or removal of any chemical substances or vessels containing chemical substances would be subject to approval in advance by your office.

Mark A. LaRose, Esq.  
December 2, 1985  
Page Two

It must be understood that Kerr-McGee's voluntary efforts to be a good neighbor and citizen of the State of Illinois in cleaning up this area is not to be construed as an admission of any legal obligation.

We have made a commitment to cooperate with your office and Mr. Lefton in this matter. However, only Mr. Lefton has the right to grant access to the site. I hope you will call me if you see any problems arising as we feel our money is better spent on landscaping than in litigation.

Sincerely yours,



Carolyn G. Hill,  
Division Counsel  
P. O. Box 25861  
Oklahoma City, OK 73125  
(405) 270-2828

CGH:mcw

xc: Maxine I. Lipeles

bxc:G. R. Hennigan  
B. L. Hoffman  
L. W. Hollensbe  
T. J. McDaniel  
A. L. Martin  
R. S. Pereles  
J. L. Rainey  
E. T. Still

HUSCH, EPPENBERGER, DONOHUE, ELSON & CORNFELD

SUITE 1800  
100 NORTH BROADWAY  
ST. LOUIS, MISSOURI 63102  
(314) 421-4800

2500 CITY CENTER SQUARE  
12TH & BALTIMORE  
KANSAS CITY, MISSOURI 64105  
(816) 421-4800

REPLY TO ST. LOUIS

December 3, 1985

Mark A. LaRose, Esq.  
Assistant Attorney General  
Environmental Control Division  
Office of the Attorney General  
Springfield, Illinois 62706

Re: Moss American Site in Sauget, Illinois

PRIVILEGED AND CONFIDENTIAL  
PREPARED IN CONNECTION WITH POTENTIAL LITIGATION

Dear Mr. LaRose:

I received your letter of November 25, 1985, regarding the above-referenced site and, in particular, the conference call of November 21, 1985 among you, Carolyn Hill of Kerr-McGee, and myself, representing Lefton Iron & Metal.

In response to your letter, Lefton Iron & Metal concurs in your preference for handling this matter on an voluntary, cooperative basis without the need for litigation. In that regard, it is our understanding that Kerr-McGee will be constructing a fence and posting warning signs at the site, as described in your letter of November 25. Lefton has already granted written permission to Kerr-McGee and its employees, agents, and representatives to enter the site for purposes of assessing and implementing remedial measures. In addition, Lefton and Kerr-McGee will undertake to assess what specific items ought to be addressed for purposes of a short-term, surface clean up and how those measures can most appropriately be implemented. I understand that Kerr-McGee will make available its in-house environmental experts for such purposes. (Insofar as your letter implies that either Lefton or Kerr-McGee will be retaining an outside environmental consultant, there must have been a misunderstanding. At the present time, we believe that the necessary environmental expertise is available within Kerr-McGee and, with respect to the non-hazardous wastes at the site, Lefton.) Finally, you have our assurance that the implementation of any further remedial measures regarding any hazardous wastes at the site will be subject to the prior approval of your office.

Mark A. LaRose, Esq.  
December 3, 1985  
Page Two

This letter will also confirm our verbal commitment to grant the Attorney General of Illinois, and his employees, agents, and representatives, access to the site for purposes of assessing and implementing any remedial measures. Lefton requests reasonable, prior notice of any such access. Please provide such notice to both Ben Lefton and myself.

This letter will also confirm that, in consideration of the foregoing, you have agreed as follows: (1) You will not file suit against Lefton or Kerr-McGee on or before December 7, 1985. (2) As long as we continue to work together on a cooperative basis, you will not resort to litigation. (3) If you believe that cooperative efforts are not being sufficiently successful, and decide to file suit, you will give the potential defendants prior notice of such determination and an opportunity to restore or resume negotiations. (4) You will do whatever your office reasonably can to ensure that any remedial measures undertaken at the site are satisfactory to the Illinois Environmental Protection Agency and that we will not be subject to two proceedings, one initiated by your office and a separate one initiated by the IEPA. (5) Upon receipt of this letter, you will forward to me copies of all samples collected and laboratory analyses performed by or on behalf of the U.S. Environmental Protection Agency at the site. It is my understanding that neither your office nor the IEPA has collected any such samples. If I am mistaken, I believe that your prior verbal commitment extends to those results as well.

I look forward to hearing from you and continuing to work with you on a cooperative basis in this matter.

Sincerely yours,

MIL

Maxine I. Lipeles

MIL/cas

cc: Carolyn Gregg Hill, Esq.  
Mr. Benjamin B. Lefton

ATTACHMENT 6  
Notification of Final SRAPL Listing





Illinois Environmental Protection Agency · 2200 Churcill Road, Springfield, IL 62706

217/782-6761

Refer to: L1631210014 -- St. Clair County  
Moss American  
Superfund/General Correspondence

March 4, 1986

Robert Goddard  
Lefton Iron and Metal  
205 South 17th  
East St. Louis, IL 62207

Pete Caskin  
Kerr-McGee Chemical Corporation  
P.O. Box 25861, Room 1202  
Oklahoma City, Oklahoma 73125

Gentlemen:

This is to advise you that Section 860.210 of the State Remedial Action Priorities List, 35 Illinois Administrative Code 860.210, has been amended to add the above referenced facility. This listing will be published in 10 Illinois Register 4226 (3/7/86). The effective date of the listing is February 26, 1986.

The identification of a site on the SRAPL is intended to guide the Agency in determining which sites warrant further investigations designed to assess the nature and extent of the risks associated with your facility. These investigations will determine what remedial action, if any, may be appropriate.

If you have any questions, please contact this office.

Sincerely,

*Monte M. Nienkerk*

Monte M. Nienkerk, Manager  
State Site Management Unit  
Remedial Project Management Section  
Division of Land Pollution Control

MMN:tk:4/7/29

cc: Division File  
Regional File  
Jim Frank  
Gary King  
Scott Phillips  
Gloria Craven

**ATTACHMENT 7**  
**Preliminary Subsurface Investigation,**  
**Moss-American Inc. Plant Site**  
**East St. Louis, Illinois**

**PRELIMINARY SUBSURFACE INVESTIGATION**

**MOSS-AMERICAN, INC. PLANT SITE**

**EAST ST. LOUIS, ILLINOIS**

**WOODWARD-CLYDE & ASSOCIATES  
10272 Bach Boulevard  
St. Louis, Missouri 63132  
S-68-4**

# WOODWARD - CLYDE - SHERARD & ASSOCIATES

(314) • TELEPHONE MA. 6-0232  
*Consulting Soil and Foundation Engineers*  
10272 BACH BOULEVARD • OVERLAND •  
ST. LOUIS, MISSOURI 63132

July 18, 1968

OAKLAND, CALIF.  
DENVER, COLO.  
OMAHA, NEB.  
KANSAS CITY, MO.  
PHILADELPHIA, PA.  
CLIFTON, N.J.  
ST. LOUIS, MO.  
SAN DIEGO, CALIF.  
SAN JOSE, CALIF.

NEW YORK, N.Y.

Moss-American, Inc.  
Security Building  
319 North 4th Street  
St. Louis, Missouri 63102

Attention; Mr. R.S. Hahn, Vice President

## PRELIMINARY SUBSURFACE INVESTIGATION

MOSS-AMERICAN, INC. PLANT SITE

EAST ST. LOUIS, ILLINOIS

Gentlemen:

We enclose our report describing a preliminary subsurface investigation at your plant site in East St. Louis, Illinois. This study was made in accordance with our proposal of June 13, 1968 after receiving your authorization on June 14, 1968.

Following initial exploratory borings, we wrote to you on June 27, 1968 confirming our telephone conversation of the same date, in which your approval was obtained to increase the scope of the investigation, because of the necessity for deeper borings, than were originally considered.

We trust that if you desire any further information concerning this report, you will not hesitate to advise us.

Very truly yours,

WOODWARD-CLYDE & ASSOCIATES

  
John A. deMonte, P.E.

  
Howard M. McMaster, P.E.

JAdM/jab  
S-68-4

## TABLE OF CONTENTS

	<u>Page No.</u>
INTRODUCTION	1
FIELD INVESTIGATION	1, 2
LABORATORY TESTS	2
SITE CONDITIONS	2, 3
SOIL CONDITIONS	3
ENGINEERING ANALYSIS	4
CONCLUSIONS AND RECOMMENDATIONS	4, 5, 6
CONSTRUCTION DETAILS	6, 7

EXHIBITS

BORING LOCATION PLAN

Figure 1

SUBSURFACE PROFILES

Figures 2, 3

SUMMARY OF LABORATORY TEST DATA

Figures 4, 5, 6, 7

CONSOLIDATION TEST

Figure 8

BORING LOG, LEGEND AND NOMENCLATURE

Figure A-2

BORING LOGS

1 thru 29

## INTRODUCTION

This report presents the results of a preliminary subsurface investigation made at the plant site of Moss-American, Incorporated in East St. Louis, Illinois.

The purpose of this preliminary study is to define the general condition of the subsoils and ground water and to provide sufficient subsurface information for determining the probable types of foundations that may be considered for the proposed facilities.

It is understood that proposed new construction is intended to expand and modernize existing facilities on the site. New structures, storage tanks, treating equipment and cylinders, railroad tracks, and storage of timber ties will be basically the same as the existing facilities. The proposed layout of the plant has not been finalized.

## FIELD INVESTIGATION

The field investigation was supervised by a geologist and consisted of drilling twenty-nine (29) borings with a truck-mounted rotary drill rig to depths of between 10 and 48 feet. A typical boring was drilled to a depth of 24 feet. The borings were laid out according to a test boring plan prepared by Benham-Blair & Affiliates, Architect Engineers of Oklahoma City, Oklahoma. The positions and elevations of the borings were determined on the site by referring to two base lines shown on the test boring plan. The ground surface elevations were obtained with a hand level and by referring to the intersection of the base lines which was assumed to be elevation 100. The borings were advanced with a 4 inch

diameter continuous flight auger. Soil samples were recovered at 5 foot intervals of depth or at changes of soil strata by driving a 2 inch internal diameter California liner tube sampler or a 2 inch OD split-spoon sampler into the soil with a 140 pound hammer falling 30 inches. The number of blows required for each 6 inch penetration of either sampler is recorded on the boring logs. Relatively undisturbed soil samples were obtained by pushing a 3 inch diameter thin-walled Shelby tube into the soil. Soil cuttings from the auger were examined continuously during the period of drilling. The boring logs are attached to this report.

#### LABORATORY TESTS

Laboratory tests were performed to provide information on the character and composition of the foundation soils. These included unconfined compression tests for determining insitu strengths, water content, dry densities, Atterberg Limits and a swell test to confirm visual classifications.

#### SITE CONDITIONS

The site is currently used for the storage and processing of untreated railroad timber ties. The area is in the flood plain of the Mississippi River, with the site being approximately one mile east of the river. The topography is essentially flat except for some locally depressed areas which include an existing slough at the south part of the site. An apparent northward extension of the slough has been filled in and contains very soft soils. Surface drainage is generally poor.



Water collection and ponding was observed in some areas. It is believed that surface water is held by the upper plastic clay layer which prevents downward seepage into the underlying more pervious sandy soils.

#### SOIL CONDITIONS

The site is covered with a 10 inch to about 3 foot thick layer of loose cinder fill, sometimes containing sand and gravel or creosote and sometimes overlaid by 12 to 15 inches of gravel. A maximum depth of 7.5 feet of loose cinders was recorded at one location. The cinder fill is generally underlain by a 6 inch to 2½ foot thick stiff gray or brown or black highly plastic clay layer. The clay layer had a maximum observed thickness of over 5 feet. In some areas the cinder fill was directly underlain by about 5 to 10 feet of loose sandy and clayey silts. The underlying soils were of low strength and were highly variable. They consisted of an irregular pattern of interlayered fine sands, silts and clays and combinations of these soils. These materials were found to be soft, loose and compressible. Medium dense fine uniform sands, often containing some silt, were encountered at depths varying from 7 to about 30 feet. With increasing depth, clean sands were observed becoming more dense within the soil profile studied.

The levels at which free water entered the borings varied considerably from a depth of 2 feet to 27 feet. The water levels measured 24 hours after each boring was completed varied from a depth of 2 feet to 25 feet. Many of the borings showed no free water during drilling or 24 hours afterward.

### ENGINEERING ANALYSIS

The soil profile above the medium dense sands contain inter-layered soft and loose sandy silts, silty clays, and clayey silts, etc. which are weak and compressible. A wide variation exists in the presence, composition, thickness and compressibility of these soils. In all areas they are expected to consolidate under relatively light loads resulting in significant settlement. In certain areas, particularly the apparent northward extension of the existing filled-in slough and other locations containing very weak soils, greater consolidation and larger settlements are likely to occur.

Suitable structure support free from subsequent settlements will require the use of driven piles founded within the underlying medium dense sand stratum. Drilled piers, apart from the probable need for casing and dewatering will be difficult to install and are not considered a suitable alternate type of foundation.

### CONCLUSIONS AND RECOMMENDATIONS

1. The site is covered with a 10 inch to 3 foot thick layer of loose cinder fill. Deeper pockets are present. The underlying soils generally consist of a layer of stiff highly plastic clay 6 inches to 2½ feet thick, followed by an irregular pattern of interlayered soft and loose sandy silts, silty clays, and clayey silts to variable depths. Very weak materials were observed in the area immediately north of the existing slough and at some other local areas on the site. Medium dense sands were encountered between depths of 7 and 30 feet.

2. All of the soils above the medium dense sands, including the stiff highly plastic clay, are compressible and will consolidate under relatively light loads resulting in structure settlement.

3. Structure support free from consolidation settlements will require the use of driven piles founded within the underlying medium dense sand stratum. Displacement piles such as timber, precast concrete or steel shells filled with concrete can be considered. A minimum pile penetration length of 12 feet into the medium dense sands should be obtained. Design pile capacities are expected to be in the range of 25 to 40 tons, depending on the type of pile, tip embedment, and the driving equipment that is used. The effects of vibrations from pile driving operations on adjacent structures should be anticipated.

4. In some areas light steel frame structures and single story sheet metal buildings with individual column loads of about 100 kips can be supported on shallow spread footings. A conservative footing design pressure equal to 1500 pounds per square foot maximum should be used for proportioning footings. They should be seated on firm to stiff natural soils. Weaker soils under footings should be removed for a depth of at least 3 feet and replaced with a properly compacted granular backfill, before the footings are constructed. Differential footing settlements of approximately 1/2 inch or more should be expected. Provision should be made for restoring deflections in structures by jacking or shimming.

5. All continuous footings and foundation walls should be reinforced top and bottom to function as grade beams. This design will tend to inhibit the effects of anticipated differential foundation movement. Minimum footing depths should provide a frost cover of at least 30 inches.

6. The 50,000 gallon storage tanks should be supported on piles in order to preclude foundation settlement. It might be possible to place the storage tanks on a carefully prepared, preloaded, and surcharged portion of the site if sufficient time is available to allow full consolidation of soft soils and settlement in fill.

7. It is understood that the 150' x 8' diameter treatment cylinder and enclosed track, must remain level for successful operation. It is recommended that these facilities be supported on driven piles.

8. The subgrade of areas for proposed roadways, exterior pavements and railroad tracks subject to heavy axial loads should be prepared before construction of these facilities. These areas should be brought to grade with a well compacted fill and a well compacted 18 inch granular base course. Compacted field densities equal to at least 95 percent of Standard Proctor density should be specified. On this basis, a California Bearing Ratio of 15 can be assumed, for purposes of pavement design.

#### CONSTRUCTION DETAILS

Often during the preparation of the detailed drawings and design, questions arise concerning our report. Because of special mechanical or structural details, sometimes it is necessary to deviate from our

recommendations. These problems can usually be reconciled easily by a brief conference between us and the designing architects and engineers.

In any foundation investigation it is necessary to assume that the subsoil conditions will not change very much between exploratory holes. The holes are spaced as closely as it is economically feasible in order to decrease the possibility of anomalies. For this reason, it is frequently advisable that the soil engineer inspect the exposed foundation excavations, especially if any unforeseen conditions are uncovered. We suggest that our firm be notified if any unexpected or suspicious appearing soils are encountered during construction.